

**ARMY ACQUISITION WORKFORCE
DEPENDENCY ON E-MAIL FOR FORMAL
WORK COORDINATION:**

**FINDINGS AND OPPORTUNITIES FOR WORKFORCE
PERFORMANCE IMPROVEMENT THROUGH E-MAIL-BASED
SOCIAL NETWORK ANALYSIS**

KENNETH A. LORENTZEN



May 2013

**PUBLISHED BY
THE DEFENSE ACQUISITION UNIVERSITY PRESS
PROJECT ADVISOR: BOB SKERTIC
CAPITAL AND NORTHEAST REGION, DAU
THE SENIOR SERVICE COLLEGE FELLOWSHIP PROGRAM
ABERDEEN PROVING GROUND, MD**

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Abstract

Army and Department of Defense (DoD) initiatives such as Better Buying Power 2.0 (Kendall, 2012) explicitly identify the need to improve defense acquisition workforce effectiveness and efficiencies. The Army Acquisition Workforce (AAW), as a large-scale geographically dispersed organization, presents significant challenges in obtaining timely and quantitative data of its organizational behavior, to support analysis and strategic decisions for improving its performance. Current research and commercial practices of companies hosting social networks (e.g., Google), reflect that significant insight into the collective behaviors of large-scale populations can be obtained from social network analysis (SNA) of e-mail and other collaboration traffic data. This research study presents the findings of an AAW survey (N=948) to assess the dependency of this workforce on e-mail to manage execution of formal work task and decision processes. These survey findings are intended to support validation of AAW corporate e-mail traffic data as a foundation for SNA-based organizational development (OD) campaigns supporting workforce improvement initiatives. This study also provides an overview of relevant OD campaign considerations, as well as a comprehensive annotated bibliography of contemporary research of e-mail-based SNA, to cultivate “art of the possible” discussions for AAW improvement.

Chapter 1—Introduction

The Army acquisition mission, like any other business in industry, constantly seeks to improve the effectiveness and efficiency of its programs. With the rapid change in technology and threats the 21st century has introduced, organizations and the processes that support them need to constantly evolve to remain “competitive” with this reality. At the time this study was written (early 2013), the media were ablaze with discussion of congressional “sequestration” and plans for furloughs across the government workforce to resolve significant budget challenges that have seen record government debt. These challenges present an urgent and sustained need for smart and difficult decisions on reshaping acquisition programs for affordability and effectiveness (i.e., modernization), to include revisiting organizational missions and staffing strategies that support these programs.

Compounding these decision challenges are the current efforts for pulling out of the wars in Iraq and Afghanistan, and large-scale near-term civilian retirement eligibility across the acquisition workforce. Thus, there is an essential need for a comprehensive and ideally data-driven methodology to support strategic-level analysis and decision making for bringing the Army acquisition workforce (AAW) through these challenges.

The field of organizational development (OD) per Donald Brown (Brown, 2011), provides a framework and practical considerations for analyzing and evolving organizational effectiveness, efficiency, and culture. Within this practice of OD, per Brown, there is a requisite diagnostic process necessary that “...provides information that allows a faster-reacting organization to emerge, one that can deal proactively with changing forces.” Brown says this OD diagnostic process focuses on two areas. The first area is the diagnosis of “the various interacting sub-elements that make up the organization ... includ[ing] the divisions, departments, products and the

relationships between them.” The second area “concerns the organizational processes. These include communication networks, team problem solving, decision making, leadership and authority styles, goal setting and planning methods, and the management of conflict and competition.” (Brown, 2011). This OD diagnostic process in practice focuses on identifying performance gaps, is cyclical, and “involves data gathering, interpretations and identification of problem areas and possible action programs.” Symptoms of these performance gaps usually are obvious, but root causes can remain hidden if a diagnostic process is not implemented.

A particular diagnostic approach to support organizational performance diagnosis is the development and analysis of sociometric models of organizational relationships and behavior. A properly developed sociometric model of an organization under an OD campaign can provide significant insight of underlying challenges creating performance gaps. The first key challenge in executing the basic OD diagnostic process is data gathering: Where and how do you get the supporting data, especially for a large-scale organization (e.g., the AAW)? This research proposes that for the AAW, under the hypothesis that e-mail can be determined to be a dominant communication medium for coordinating formal work tasks, that e-mail traffic is a high-value data set to support sociometric analysis of the workforce.

Background and Motivation

Because of the scale of the Army acquisition workforce, acquiring, analyzing, and presenting relevant and actionable organizational performance data across this enterprise at an executive level is a daunting task, but would pay significant dividends if made possible. Carnegie Mellon University’s Software Engineering Institute (CMU SEI) recognized the inherent challenges of large-scale OD in its research of “Ultra-Large Scale Systems” (ULSS). Explicitly identified as “further research” in this SEI research (Northrup, 2006) is that organizations managing ULSS

efforts are themselves ultra-large-scale systems in their own right, and new management techniques for executing the ULSS challenge are needed. For purposes of this study, this SEI research challenge is acknowledged and assumes the Army acquisition workforce to be an Ultra-Large-Scale Organization (ULSO).

Current trends in the field of Social Network Analysis (SNA) are addressing the complex challenges of analyzing even bigger and less formally defined populations than the ULSO AAW—i.e., “friend” networks in Internet collaboration environments such as Facebook. The application of SNA approaches are explicitly leveraged by Internet companies such as Google, which provide free e-mail and other social network technologies simply to leverage the marketing and other intrinsic value of the information these user accounts will contain.

To cite a more AAW specific motivation of this research, the DoD has published the “Better Buying Power (BBP) Initiative 2.0” (Kendall, 2012), which calls for defense-wide “Eliminat[ion of] unproductive processes and bureaucracy” as well as “improve[ment] of the professionalism of the total acquisition workforce.” (Kendall, 2012). Although this paper does not suggest that an SNA approach alone can address these ambitious goals, the SNA approach as part of a comprehensive OD campaign would provide a real-time, large-scale data source of actual organizational behaviors that can be considered in the context of strategic organizational transformation decisions. These specific BBP tenets (along with the current fiscal and political realities reflected in the introduction) provide an overarching motivation to propose consideration of an SNA approach that can measure ULSO effectiveness and support decisions in meeting this DoD challenge.

Thus, the focus of this research is twofold: First, the hypothesis that there is a significant AAW dependency on e-mail supporting formal work task and decision activities. That would make

e-mail traffic data a viable data source for an SNA-based OD campaign. Second, this research provides a comprehensive literature review, including an annotated bibliography that reflects contemporary research efforts supporting SNA-based organizational analysis that can (and should) readily be considered in this context of AAW OD. This literature review is provided to provoke thought into the “art of the possible,” for use of SNA approaches to deliver a highly scalable organizational behavior analysis capability.

Problem Statement

Senior AAW leadership effectively is destitute of quantitative real-time organizational behavior and performance data necessary to evaluate and strategically transform the workforce for current and future challenges. The AAW, as a ULISO, is an inherently difficult source of objective performance data, in support of quantitative organizational effectiveness and efficiency analysis. E-mail is an omnipresent technology across all AAW organizational activities, from which enormous amounts of collaboration data between AAW members is technically available “on tap,” if desired. Tapping that e-mail data can be done unobtrusively and in real time, unlike surveys. However, the validity of this e-mail traffic as an SNA-supporting data source must be determined to confirm the potential of e-mail-based SNA capabilities to support AAW organizational performance analysis.

Purpose of This Study

This study’s primary purpose is to survey a large cross-section of the AAW to determine the current and projected dependencies and utilization of e-mail in support of formal task management and execution. By analyzing these survey data, the hypothesis that AAW e-mail traffic data can serve as a valid data source for SNA-driven AAW OD efforts can be determined.

A secondary purpose of this study is to present contemporary research in e-mail-based SNA techniques, to promote discussion in consideration of what can be leveraged to support AAW organizational behavior analysis. Considerations such as tools, methods, measures, data representation, and mathematical foundations of SNA, as well as ethics, privacy, and security concerns inherent to this SNA are presented as an annotated bibliography at the end of this study.

Significance of This Research

The significance of this research is twofold. First, the research determines the AAW dependency on e-mail to support formal work tasks and decision making. With this dependency quantitatively known, the viability of AAW e-mail traffic data to support a highly scalable OD campaign to improve AAW organizational effectiveness and efficiency can be determined. The application of this SNA capability to support critical optimization and reform decision challenges of senior AAW leadership could provide a critical contribution to decision support activities in addressing current government, DoD and AAW challenges such as the Better Buying Power Initiative 2.0 (Kendall, 2012). The second significant component of this research is to promote discussion on the potential of an e-mail-based SNA approach to OD efforts by providing a comprehensive snapshot of contemporary research in this area.

Overview of the Research Methodology

The research methodology is the performance of a Web-based survey, with participation solicited via e-mail over a broad population of the AAW (N=948). A literature review, coupled with an annotated bibliography, provides background and a snapshot of contemporary SNA research complementary to the motivations of this research.

Research Questions

1) Demographic Questions:

- a) Identify Age: 25 or younger, 26-35, 36-45, 46-55, older than 55
 - b) Identify Gender: M/F
 - c) Identify GS Grade/Rank or equivalent: GS-7/8/2LT, GS-9/10/1LT, GS-11/12/CAPT, GS-13/MAJ, GS-14/LTC, GS-15/COL, SES/GO
 - d) Identify Acquisition Career Program: (A drop-down box to select the current acquisition program field of the individual is provided. The list is provided as an appendix due to length.)
- 2) Research Specific Questions:
- a) Approximately how much coordination of your formal work tasks are accomplished or coordinated with e-mail? Select from: more than 90 percent, 75-90 percent, 50-74 percent, 25-49 percent, less than 25 percent.
 - b) Do you formally coordinate with anyone necessary for execution of your job responsibilities completely independent of e-mail? Select Y/N.
 - c) Do you anticipate that your current utilization of e-mail for formal work task coordination will significantly shift to other forms of collaboration over the next 5 years? Select Y/N.

Research Hypothesis

H1: It is hypothesized that there is a strong dependency on e-mail as a communication mechanism of the AAW, to support formal work tasks and decision making.

H0: E-mail utilization is not a dominant communication medium of the AAW, and its use in SNA-based organizational strategy and decision making would not adequately reflect communication patterns and derived behaviors.

Objectives and Outcomes

The specific objective of this research is to evaluate the AAW dependency on e-mail as a communication mechanism in support formal work tasks and decision making.

This research will produce an outcome represented by graphical results of an AAW survey that solicited e-mail dependency metrics, and supporting demographic data.

Limitations of the Study

The data survey distribution of this study was limited to 6,741 AAW members whose parent organizations are resident at Aberdeen Proving Ground (APG), MD. This limitation was done for practical reasons in efficiently deriving a large representative e-mail distribution list, which typically are managed geographically. APG was chosen since this workforce represented many large acquisition organizations, including two Program Executive Offices (PEOs), a large research and development (R&D) organization, as well as a large Life Cycle Management Command (LCMC) and subordinate centers.

Validity of the Research

The validity of this research is determined by simple consideration of the accuracy and trustworthiness of the data collection instrument and administration process.

Reliability of the Responses

The reliability of the responses is considered in two contexts: The fidelity of the survey tool to capture and manage the survey data, and the understandability of the survey questions by the survey participants to answer the questions consistently. The survey tool (SurveyMonkey) is a mature, database-driven product with no known flaws or limitations that would affect survey reliability. The survey questions, consisting of three very simple e-mail utilization questions, and three very simple demographic questions, represented little complexity that would inherently taint

the consistency of the survey reliability. Only four of the 952 surveys started went uncompleted, indicating the survey was comprehensible and concise enough to keep motivation high enough for the overwhelming majority of the participants to complete the survey.

Chapter 2—Literature Review

Overview

This chapter provides a literature review of primary considerations.

The purpose of this research is primarily to validate that AAW e-mail traffic is a viable data source to support SNA opportunities for improving the AAW organizational performance and decision cycles. In this context, this literature review first reflects the value and motivation of a SNA approach to supporting AAW OD initiatives.

The next section of this literature review provides an overview of the emerging field of OD, as grounding to requirements drivers of SNA strategies and metrics. Further enforcing the motivation of this research, the following section of this literature review identifies specific contemporary DoD and Army initiatives that could benefit from this approach.

For completeness in communicating the motivations of this research, an annotated bibliography is provided at the end of this study, to reflect relevant SNA research areas that can be leveraged for future ventures in AAW OD. This annotated bibliography is intended to mostly reflect “the art of the possible,” as well as studies in inherent challenges to an SNA-based OD initiative, but not to reflect all possible areas of application.

The Inherent Value of SNA

There are two specific views of an SNA-based OD approach that should be appreciated. First, the e-mail data exist and (as validated by his research) constitute a dominant communication mechanism for facilitating collaboration among AAW members. Since these e-mail data are generated as a natural part of business execution across the enterprise, and assuming the richness of the data is adequate for a particular needed study, SNA-based OD ventures do not require additional (burdensome) surveys of the workforce: The e-mail data are effectively free and real-

time continuous with the right computing resources applied to its collection and analysis. Second, with the explosion of social collaboration capabilities on the Internet such as Facebook and Twitter, SNA is a strongly emerging area of research in commercial areas (e.g., marketing), thus an Army venture into SNA OD can capitalize on these commercial investments. The annotated bibliography of this study should be consulted for additional insight into SNA applications relevant to this study.

Discussion on the Tenets of Organizational Development

This section provides a general discussion on OD as an exemplar field of study and supporting methodology appropriate for SNA-based organizational analysis. Per Donald Brown (Brown, 2011), the field of Organizational Design is focused on an accepted need for continual change and renewal of organizations, to improve organizational effectiveness and efficiency. Specifically, Brown cites Richard Beckhard to define OD as “an effort [that is] 1) planned, 2) organization-wide, 3) managed from the top, 4) to increase organization effectiveness and health, thorough 5) involves planned interventions in the organization’s processes using behavioral science knowledge” (Beckhard, 1969). To achieve these specific tenets, organizational data for assessment, decisions and feedback on intervention efforts are required.

A third leg to OD tenets of effectiveness and efficiency identified by Brown is that organizational *culture* is very significant to organizational performance. There are recent studies that clearly reinforce the value in addressing cultural changes as a key driver in organizational success. The following paragraphs provide reinforcement to the consideration of culture in OD ventures.

Cameron and Kim cite some very significant statistics regarding the impact of culture on organizational success (Cameron & Quinn, 2006, p. 3). Specifically, the top five performers in the

past 2 decades (based on financial returns) are “Southwest Airlines (21,775 percent return), Wal-Mart (19,807 percent return), Tyson Foods (18,118 percent return), Circuit City (16,410 percent return) and Plenum Publishing (15,689 percent return) (Compustat Data Services, 2005). Cameron and Kim point out that these companies compete in some of the highest-risk and most turbulent industries of the day, yet are the top performers in the U.S. economy. The big difference cited by Cameron and Kim is “The major distinguishing feature in these companies, their most important competitive advantage, the most powerful factor they all highlight as a key ingredient in their success, is their organizational culture.” (Cameron & Quinn, 2006, p. 4).

The value of corporate culture also is well documented for Defense and Army acquisition programs. In a very interesting study published in January 2012 by the Defense Acquisition University’s (*Defense Acquisition Research Journal (ARJ)*) titled “The More Things Change, Acquisition Reform Remains the Same,” Col. Peter Eide (USAF) and COL Charles Allen (USA, Retired) provide a comprehensive review of all the significant acquisition reforms of the U.S. government and DoD. The foundation of their study is a comparative analysis of these acquisition programs against John Kotter’s well recognized “Leading Change” principles (Kotter, 1996). In their summary, they state:

Acquisition reforms can be coerced, but will not endure as true transformation unless cultural change occurs. Success requires commitment to change over simple compliance to superficial rewards and consequences. Effective reform requires embedding leadership actions and institutional processes to drive change in the culture of defense acquisition. It is time to undertake a long-term, culturally focused effort to transform DoD’s acquisition process. (Eide & Allen, 2012).

Building on this culture sentiment, a recent RAND Corporation study captured the lessons learned from the canceled Army Future Combat System (FCS) program. This study first cited a December 2005 study in the *Defense ARJ*, noting that “the major difficulties in the FCS program, to that point, were in the organizational culture” (RAND Arroyo Center, 2012). The study then cites “several government co-leads serving on IPT’s [Integrated Product Team’s] believed that program culture and policies suppressed their ability to exercise their fiduciary responsibilities for oversight,” (RAND Arroyo Center, 2012). This RAND study is a document rich in lessons to be learned in regard to organizational culture and values, including a citing of a Government Accountability Office (GAO) study reflecting the sentiment that “Government agents cited that the [Lead System Integrator] was pandering to its own interests rather than the government’s interests as desired, though that would be not unexpected from a private entity. The GAO said it was unreasonable for the Army to expect a private entity to act in the best interest of the government if doing so conflicted with its corporate interests.” (RAND Arroyo Center, 2012). These interest conflicts between the government and the Lead FCS Integrator clearly reflect a poor alignment of values and culture in a team that was supposed to be “one team.”

With the significance of culture iterated here, a key motivator to SNA-based OD is that SNA research looks promising to supporting aspects of organizational culture evaluation from patterns and content of e-mail (and other collaboration medium) traffic. Therefore, an otherwise very difficult metric to capture and evaluate (especially in real time) may become possible in an SNA-based approach.

Current DoD and Army Acquisition Reform Motivations

U.S. Army acquisition workforce development strategy, to include assumption of edicts from DoD and higher government organizations, is never without programs, initiatives, and

directives targeted to improve areas of acquisition deemed to be significant challenges in their time. More often than not, these initiatives target “process and product,” looking to lean processes as well as promising technologies that can improve the effectiveness and efficiency of the products and services they provide. This is not unique from a government perspective, recognizing that commercial companies and organizations readily lean toward process and technology initiatives for gains in effectiveness and efficiency as well, with “Lean Six Sigma,” “Capability Maturity Model Integrated (CMMI),” “ISO 9000,” and “Total Quality Management (TQM)” serving as popular exemplars to these initiatives.

However recently, DoD has published the “Better Buying Power Initiative 2.0,” which calls for defense-wide “Eliminat[ion of] unproductive processes and bureaucracy” as well as “improve[ment] of the professionalism of the total acquisition workforce” (Kendall, 2012). These specific BBP tenets implicitly call upon OD principals (per Brown, 2011) to address these challenges, and thus they provide an overarching motivation of this study to focus on OD aspects of effectiveness and efficiency.

But the size and complexity of the AAW, providing AAW leadership with quantitative metrics into areas and activities supporting these initiatives would be difficult if not impossible with conventional reporting means. In this light, modern computing capabilities, applied to an SNA approach to supporting real-time OD metrics collection from e-mail traffic, could be a critical enabler to effective AAW leadership OD decisions.

Chapter 3—Research Methodology

Research Hypothesis

H1: It is hypothesized that there is a strong dependency on e-mail as a communication mechanism of the AAW, to support formal work tasks and decision making.

H0: E-mail utilization is not a dominant communication medium of the AAW, and its use in SNA-based organizational strategy and decision making would not adequately reflect communication patterns and derived behaviors.

Research Process

The research process consists of the design and execution of a survey to obtain e-mail utilization metrics, including demographic data of participants. With these data, analysis of the data for assessing overall e-mail utilization and dependencies—including analysis against areas of age, gender, seniority, and career field—is performed to see if significant deviation exists in these areas that would affect the validity of e-mail-based SNA in certain demographics.

Data Collection

The SurveyMonkey (www.surveymonkey.com) tool was utilized to design, administer, and collect the survey data for this research. Organizational e-mail distribution lists supported the dissemination of the survey across the sample population of the AAW.

Chapter 4—Findings

The following paragraphs provide the surveyed demographic data of the survey responders, as well as the collected data of the survey itself. As previously stated, the data survey distribution of this study was limited to 6,741 AAW members whose parent organizations are resident at APG, MD. This limitation was done for practical reasons in efficiently deriving a large representative e-mail distribution list, typically managed geographically. APG was chosen since this workforce represented many large acquisition organizations including two PEOs, a large R&D organization, as well as a large LCMC and subordinate centers.

Population and Sample Size

From the initial 6,741 surveys distributed, 952 responses were received with four responses partially incomplete, resulting in N=948. The following paragraphs capture three significant demographic views of this sample set.

Survey Participant Age Distribution

This data reflect Question No. 4 of the survey (i.e. “Please select your age bracket”), which is the first of three demographic questions in the survey. The significance of this survey question was to assure capture of the age distribution of the survey responses, to support considerations of generational changes in technology acceptance and utilization. The respondent population reflects a solid cross-section of the workforce composition by age distribution. Also note that the graph reflects the typical “bathtub curve” of the government workforce age distribution, with an observed dip in middle-aged employee representation.

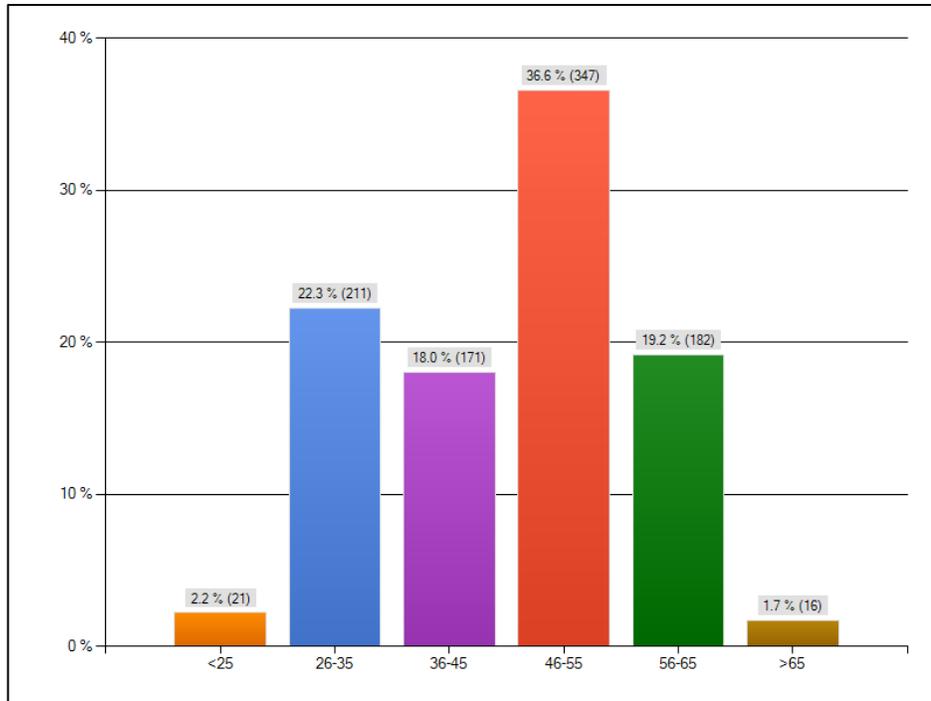


Figure 1. Survey Participant Age Demographics

Survey Participant Pay Grade/Rank Demographics

The following below reflects the answers to survey Question No. 5 (i.e., “Please select Military/GS Grade/Rank or equivalent”). The significance of this survey question is to assure the distribution of respondents reflected a good cross-section of seniority and authority levels, to include senior-level decision makers. The graph reflects that the survey respondent distribution reflected a heavy component of action officers and senior decision-making leadership. This is a key distribution to have if e-mail-based SNA were to be used to assess significant aspects of organizational behavior such as decision trees and key relationship analysis. The small contribution of pay grades below GS-11 is expected, since the majority of the AAW is college-educated, which qualifies most of the workforce for higher levels of the pay scales.

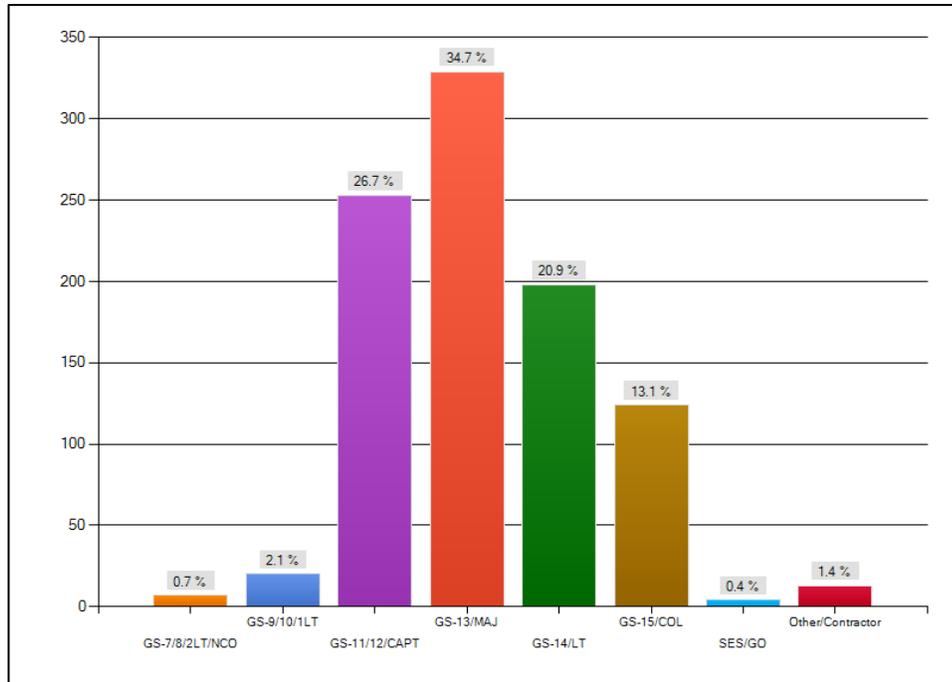


Figure 2. Survey Participant Pay Grade/Rank Demographics

Survey Participant Career Field Demographics

Figure 3 captures the demographic data results of survey Question No. 6: “Please select your Acquisition Career Program.” (The list of available selections for responding to this question is captured in Appendix A.) The key takeaway here is that despite an expected dominance of engineers and scientists, there is healthy representation across career programs that would be considered “key” in the general structure of an acquisition IPT. Since the survey distribution list was simply generated against employees associated with organizations with geographic residence at APG (which represents a solid cross-section of acquisition organizations), it would be expected that this represents the general distribution cross-section of this population independent of this survey.

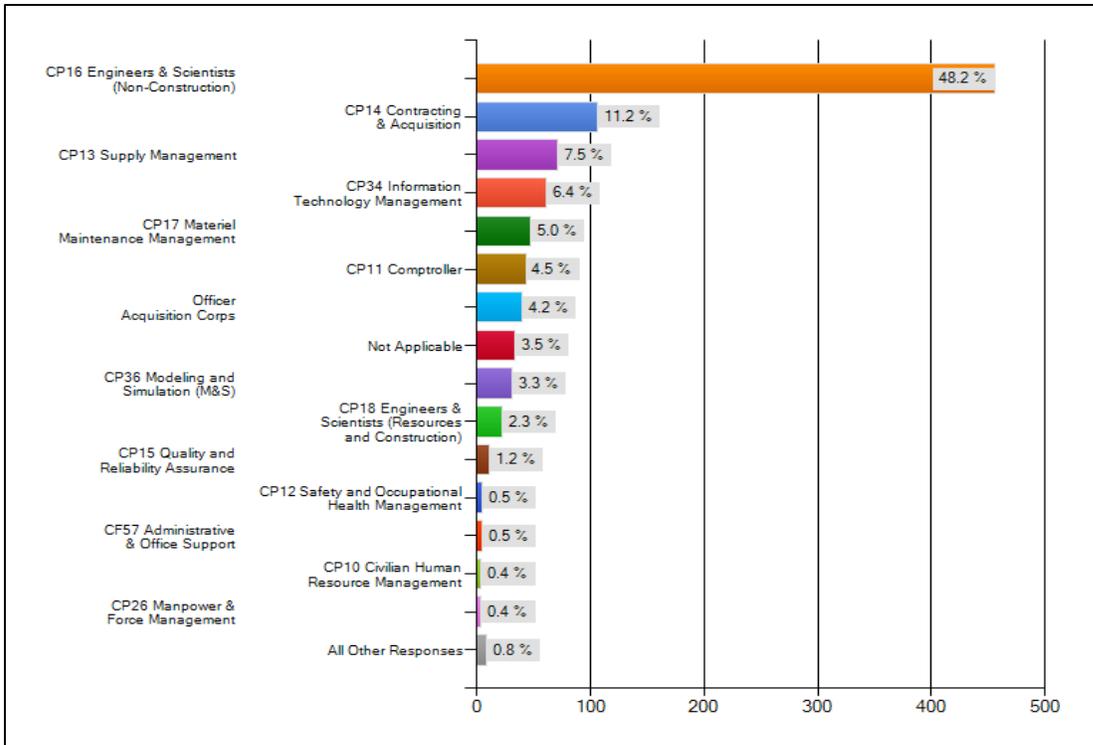


Figure 3. Survey Participant Career Field Demographics

Collected Data

Survey Participant Dependency on E-mail

Figure 4 represents the responses to survey Question No. 1: Approximately how much coordination of your formal work tasks is accomplished or coordinated with e-mail? Thus, it displays percent of dependency on e-mail for formal work coordination (x axis), against distribution of responders (y-axis). For example, the first bar of the graph states “28.5 percent or 274 of the responders claim greater than 90 percent dependency on e-mail for formal work task coordination.

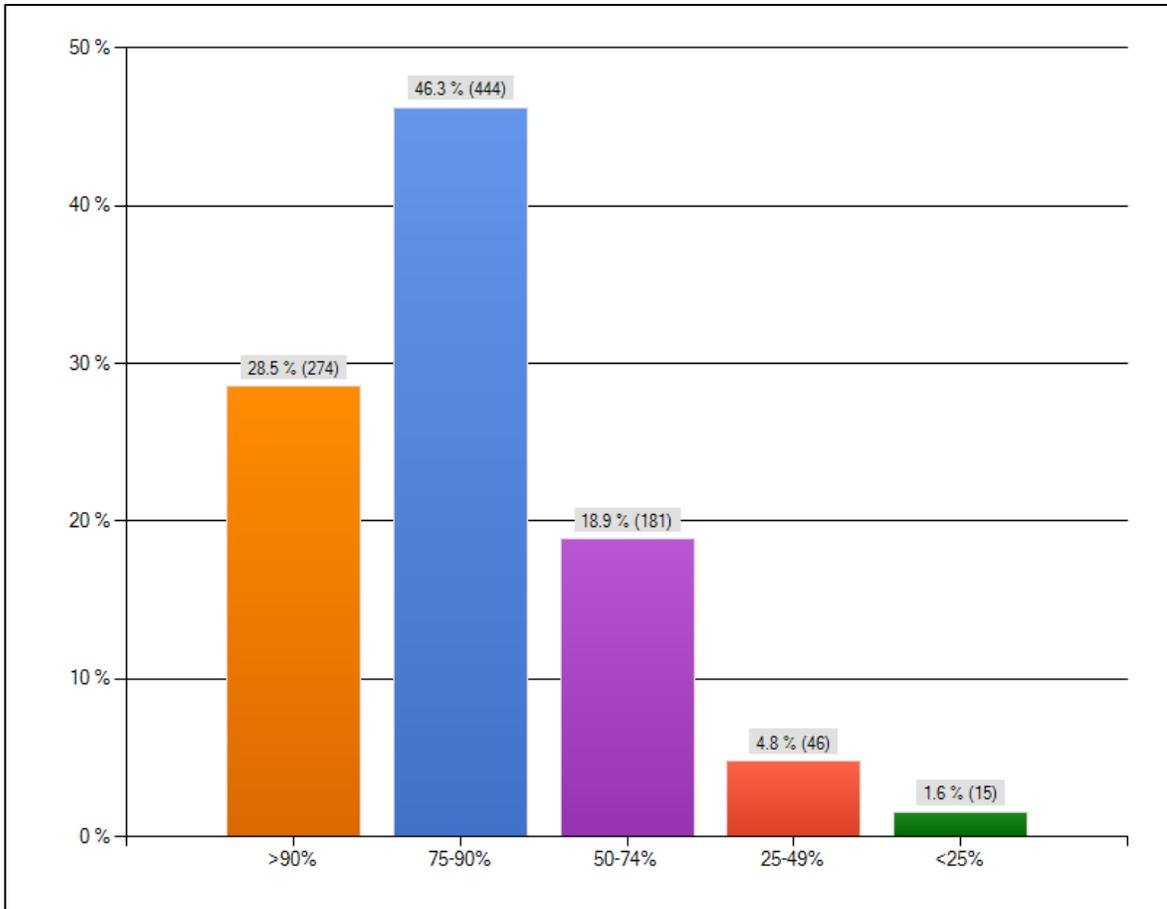


Figure 4. Survey Participant Dependency on E-mail

Coherency of Work Relationships to E-mail Traffic Data

Figure 5 captures the responses to survey Question No. 2: Do you coordinate with anyone, completely independent of e-mail, for execution of your formal job responsibilities? Thus, this graph displays the coherency of work relationships as reflected in the respondents' e-mail traffic data. In other words, this graph reflects that 65.6 percent or 629 of the survey respondents say they exchange e-mail (independent of frequency) with everyone with whom they formally work. The significance is that if the data were used to generate a sociomap of work relationships from e-mail traffic data, the data would reflect the confidence in completeness of the sociomap. The data do not reflect the intensity of the relationships, only their probable existence.

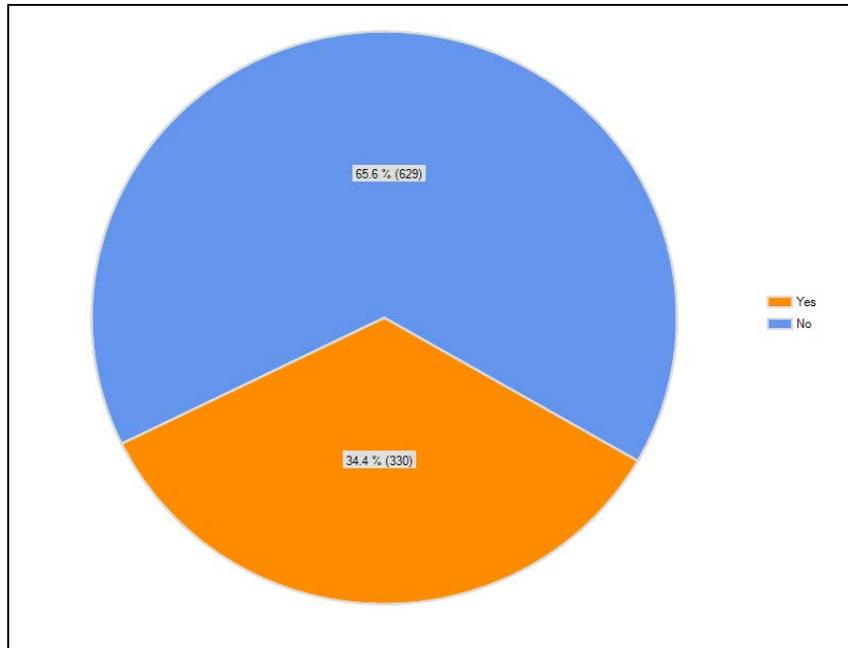


Figure 5. Coherency of Work Relationships to E-mail Traffic Data

E-mail Utilization Trend Forecast

Figure 6 represents the responses to survey Question No. 3: “Do you anticipate that your current utilization of e-mail for formal work task coordination will significantly shift to other forms of collaboration over the next 5 years?” The significance of this is that 82.1 percent of the respondents indicate they don’t anticipate a significant change in e-mail dependency over the next 5 years. This provides an indicator of confidence in stability of the e-mail data set validity for future sociometric or SNA-based studies.

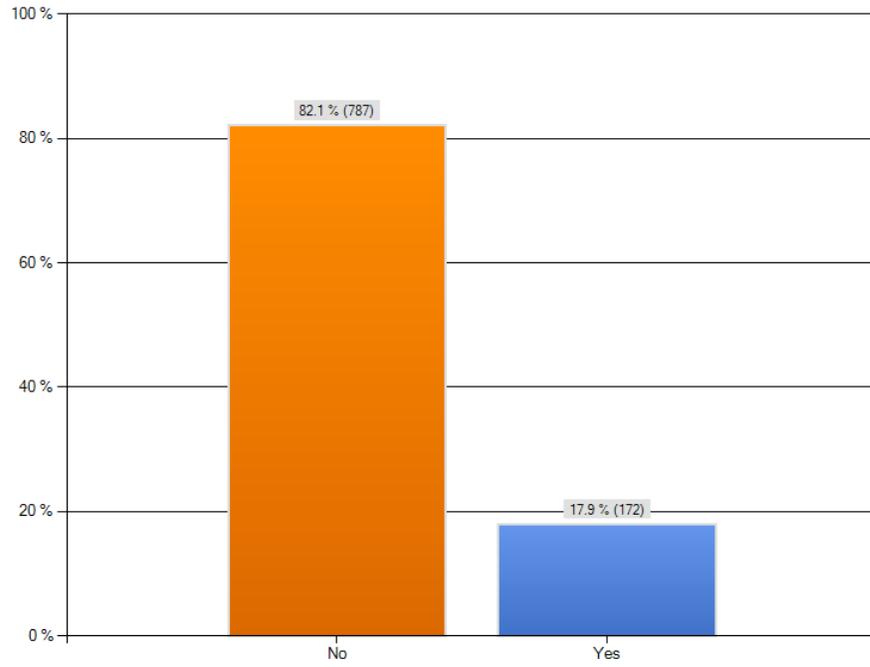


Figure 6. E-mail Utilization Trend Forecast

Chapter 5—Discussions on Findings, Conclusions, and Recommendations

The following paragraphs provide the surveyed demographic data of the survey responders, as well as the collected data of the survey itself. As previously stated, the data survey distribution of this study was limited to 6,741 AAW members whose parent organizations are resident at APG, MD. This limitation was done for practical reasons in efficiently deriving a large representative e-mail distribution list, typically managed geographically. APG was chosen since this workforce represented many large acquisition organizations including two PEOs, a large R&D organization, as well as a large LCMC and subordinate centers.

Discussions on Survey Respondent Population Demographics and Sample Size Data

From the initial 6,741 surveys distributed, 952 responses were received with four incomplete responses, resulting in N=948. Within this sample set, representing 14 percent of the surveyed workforce community, there was clear representation of a broad and representative cross-section of the AAW, from an age, pay grade/rank, and career field perspective.

Discussion on Age Demographics

The significance of the survey question soliciting the age bracket of the employee was to assure the age distribution of the survey responses was captured, to verify a broad age group was surveyed. A broad age distribution is important to nullify data biases that generational changes in technology acceptance and utilization could generate. The respondent population age data reflects a solid cross-section of the workforce composition by age distribution, as expected in a government workforce of primarily college-educated individuals (who would start their careers in their mid-20s), up to a rolloff of population at the retirement eligible age of 55. Also note that the graph reflects the typical “bathtub curve” of the government workforce age distribution, with an observed dip in middle-aged employee representation.

Discussion on Survey Participant Pay Grade/Rank Demographics

The significance of capturing the distribution of pay grade/rank demographics of the survey responders is to assure the distribution of respondents reflected a good cross-section of seniority and authority levels, to include senior-level decision makers. The survey data reflect that respondent distribution reflected heavy component of action officer level and senior decision-making leadership: This is a key distribution to have if e-mail-based SNA were to be used to assess significant aspects of organizational behavior such as decision trees and key relationship analysis. The small contribution of pay grades below GS-11 is expected since the majority of the AAW is college educated, which qualifies most of the workforce to enter the AAW at higher pay levels.

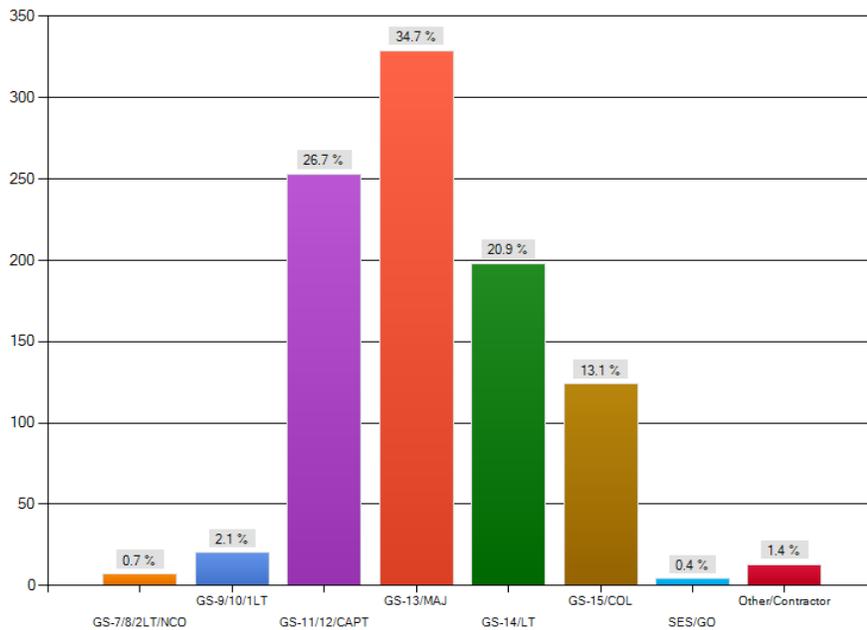


Figure 7. Distribution of Pay/Rank Demographics

Discussion of Survey Participant Career Field Demographics

The key takeaway from the collected survey career field demographic data is that, despite displaying an expected dominance of engineers and scientists, there is healthy representation across career programs that would be considered “key” in the general structure of an acquisition program management office (PMO), PEO, or IPT. Thus, the survey data reflect a well-balanced representative cross-section of the desired AAW career fields to assure that the e-mail dependency data are not overly biased toward particular or dominant workforce communities (e.g., engineers).

Discussion on Collected Data

The following paragraphs provide discussion on the core survey data, reflecting the e-mail dependencies of the surveyed workforce.

Discussion on Survey Participant E-mail Dependency as a Percentage of Formal Work Task Coordination

Figure 4 represents the responses to survey Question No. 1: Approximately how much coordination of your formal work tasks is accomplished or coordinated with e-mail? Thus, it displays percent of dependency on e-mail for formal work coordination (x-axis), against distribution of responders (y-axis) (i.e., the first bar is interpreted as 28.5 percent (or 274) of the responders claim greater than 90 percent dependency on e-mail for formal work task coordination).

From these data, it’s easy to calculate that 74.8 percent of the respondents depend on e-mail for coordination of at least 75 percent of their formal work task coordination, and 93.7 percent of the respondents depend on e-mail for at least 50 percent of their formal work task coordination. From these data, we can readily conclude there is a very strong dependency on e-mail for formal coordination of formal work tasks by the AAW.

Discussion on Coherency of Work Relationships to E-mail Traffic Data

Figure 5 captures the responses to survey Question No. 2: Do you coordinate with anyone, completely independent of e-mail, for execution of your formal job responsibilities? Thus, this graph displays the coherency of work relationships as reflected in the respondents' e-mail traffic data. In other words, this graph reflects that 65.6 percent (or 629) of the survey respondents state that they exchange e-mail (independent of e-mail exchange frequency) with everyone with whom they formally work. The significance of this data point is that, if used to generate a sociomapping of work relationships from e-mail traffic data, it would reflect the confidence in completeness of the sociomapping. The data do not reflect the intensity of the relationships (i.e., amount of e-mail exchanged), only the probable existence of the relationship between e-mail exchange pairs. From this, we can conclude that a derived sociomapping from AAW e-mail traffic also would include a strong component of weak relationships between employee pairs. Although not part of the survey data set, organizational distribution lists also would contribute to derivation of formal e-mail relationships in a group context that would further strengthen a sociomapping derived from e-mail traffic data.

Discussion on E-mail Utilization Trend Forecast

Figure 6 data represent the responses to survey Question No. 3: "Do you anticipate that your current utilization of e-mail for formal work task coordination will significantly shift to other forms of collaboration over the next 5 years?" The significance of this is that 82.1 percent of the respondents indicate they don't anticipate a significant change in e-mail dependency over the next 5 years. This provides an indicator of confidence on stability of the e-mail data set validity for future sociometric or SNA-based studies. From this, we can conclude that an investment in tools and processes to support e-mail-based SNA would not become readily obsolete, and that change

trends reflected in sociomapping evolution would represent a component of changes due to e-mail utilization behavior shifts along with organizational behavior changes.

Conclusions and Recommendations

The prime motivation of this study was to address the reality that senior AAW leadership is effectively destitute of quantitative real-time organizational behavior and performance data necessary to evaluate and strategically transform the workforce for current and future challenges. The AAW, as a ULSO, is inherently difficult to acquire objective performance data via traditional means (e.g., surveys), in support of quantitative organizational effectiveness and efficiency analysis. E-mail, as an omnipresent technology across all AAW organizational activities, generates enormous amounts of collaboration data between AAW members, and, through the findings of this study, presents a viable “on tap” data set to support workforce performance analysis.

A secondary purpose of this study was to present contemporary research in e-mail-based SNA techniques, to promote discussion in consideration of what can be leveraged to support AAW organizational behavior analysis. Considerations such as tools, methods, measures, data representation, and mathematical foundations of SNA, as well as ethics, privacy, and security concerns inherent to this SNA are presented as an annotated bibliography at the end of this study. These discussions are intended to introduce the reader to the “art of the possible,” reflect that scholarly research is validating SNA approaches to organizational behavior analysis, and promote further discussion and research specific to AAW challenges (e.g., the Better Buying Power Initiative 2.0 (Kendall, 2012)).

Also discussed in this study was a brief overview of relevant OD tenets, methodologies and organizational change campaign considerations, per Brown (Brown, 2011). OD focuses explicitly on the three aspects of organizational performance: effectiveness, efficiency, and culture. This

study cited several specific cases of organizational performance reform failure, including Army acquisition programs, directly attributed to failure to address cultural considerations in improving the workforce performance. A takeaway from this study should be to ensure that cultural considerations are explicit in any endeavor to improve AAW organizational performance. The work of Cameron and Quinn (Cameron & Quinn, 2006) is a good starting point to gain an appreciation of the cultural aspects of organizational performance.

In conclusion, it is recommended that AAW leadership consider application of the e-mail-based SNA approaches in future efforts to improve organizational performance. Future study and research into emerging analysis heuristics would be necessary to assure clear understanding of requirements and expectations. It also is recommended that the services be obtained of an OD practitioner with expertise in SNA-based organizational behavior analysis. Intuitively, resources being applied to cybersecurity surveillance of e-mail systems may be leveraged to support data acquisition and analysis, to reduce start-up costs and leverage requisite technical subject matter expertise.

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Annotated Bibliography

Ballinger, G., Craig, E., Cross, R., & Gray, P. (2011). A stitch in time saves nine: Leveraging networks to reduce the costs of turnover. *California Management Review*, 53(4), 111-133. Retrieved from <http://www.jstor.org/stable/10.1525/cmr.2011.53.4.111>.

Recognizing the cost of employee turnover, the authors identify a novel approach to analyzing email traffic, as an application of Organizational Networks Analysis (ONA) (also known as Social Network Analysis (SNA)) to address three key challenges: Flight risk of employees, identifying and retaining valuable employees, and improving organizational resiliency in face of turnover.

The overarching approach is developing sociometrics that generate employee-group mappings, which reflect the coupling and cohesiveness of an employee to other employees and groups in the organization. This is done as an analysis of sender-receiver patterns, to calculate “who is talking to whom,” how often, and if desired, filtered by topic or organizational affiliation. With these data, employees who are poorly coupled to the organization (based on weak email connectivity patterns), tightly coupled groups of expertise, as well as influential people and informal groups can be identified and leveraged toward meeting the key challenges of the study.

A key strength of this study is it delegates the technical analysis of the approach to an appendix, and leaves the body of the study to be highly intuitive to anyone familiar with email communication. It also cites much value-added statistical data to reinforce the ONA approach, in the context of real-world HR and OD challenges.

One assumption of this research is that the dominant communication medium is email. If there are employees or groups who predominantly communicate in other ways

(face-to-face, telephone, chat, phone texting, etc.), these communication data are missing from the analysis, which may therefore miss identifying particular challenges in question.

Bonchi, F., Castillo, C., Gionis, A., & Jaimes, A. (2011). Social network analysis and mining for business applications. *ACM Transactions on Intelligent System Technology*, 2(3), 22:1-37. doi: 10.1145/1961189.1961194.

The purpose of this paper is to provide an overview of relevant SNA problems, particular to a business process perspective. This, from an OD perspective, looks into effectiveness and efficiency of business processes, with human resources-related organizational challenges a subset of this larger perspective. In particular, the authors address “data acquisition and preparation, community structure and network dynamics, propagation and expert finding,” and provide future research directions in this context.

The research of this paper is grounded onto the *American Productivity & Quality Center (APQC) Process Classification Framework*, which defines a set of “Operating Processes” and “Management and Support Processes,” and identifies a mapping between a specific “process group or activity” to a “technical area” of SNA application. This is a key product for grounding the focus of this document, providing a foundation to a holistic overview of readily identifiable business functions and their SNA applicability.

True to the stated intent of the research, the paper is a comprehensive overview of business process relevant SNA application. More interesting to an OD practitioner focused on people aspects of this area, the research captures key tenets of privacy and anonymisation of the data sets; legal and ethical challenges with SNA; cultural

factors; reputation, trust and expertise in derived social ties; expert finding (teams and individuals); community structure and network dynamics; and information propagation and virality (and its impact on influence).

This research provides a very valuable overview of any OD practitioner seeking to leverage SNA methodologies to evaluate and manage change initiatives in an organization that has a data foundation suitable for analysis. Most organizations minimally will have email archives that would support these initiatives.

Brown, D. R. (2011). *An experiential approach to organization development*. (8th ed. ed.). Boston: Prentice Hall.

This text by Donald Brown is included in this bibliography as a grounding reference into Organizational Development (OD) theory and practice, which is contemporary to the other research in this document. Of particular interest, the basic OD tenets of improving organizational effectiveness, efficiency, and culture should be a fundamental grounding for all data and analysis derived from SNA activities.

Of particular interest to this bibliography, Brown highlights a comprehensive OD process to follow, within which the applicability (or utility) of SNA methods should be investigated to improve the OD campaign as a whole, especially in the diagnostic process. Brown also calls out some fundamentals on sociometrics and sociograms, which are basic data concepts behind more advanced SNA activities.

Interestingly, data derived from SNA data mining activities support the OD system approach promoted by Brown, and provide inherently correlated visibility into his “Sociotechnical System,” specifically the “coordinated social and technical activities” of the organization as reflected by its social network data (e.g., email).

Brown dedicates significant discussion into the complexities of data collection and analysis during the Diagnostic Phase. Further research into SNA for identifying organizational performance gaps, and managing the closing of these gaps during OD change activities, would be well appreciated in the context of the challenges Brown identifies with data collection and analysis, as well as for developing and communicating feedback for maintaining stabilized OD campaigns.

Golbeck, J., & Hendler, J. (2004, July). *Reputation network analysis for email filtering*. Paper presented at the *First Conference on Email and Anti-Spam*, Mountain View, CA. Retrieved from <http://ceas.cc/2004/177.pdf>.

As a spin on current email spam filtering approaches (which look to identify and delete “junk” email), the authors propose a filtering scheme that infers or acts upon a “reputation rating” or “trust score” on email, and then derives social networks among individuals with favorable ratings, as part of a “white list.”

There are several significant opportunities with this type of rating capability deployed in an OD campaign. For instance, if an OD change agent wanted to identify key “guiding teams” (to use Kotter’s term) (Kotter, 1996) to drive organizational change initiatives, a tuned filter seeking groups of “trusted innovators” could be developed and applied. A really interesting aspect of this approach is that the discovered team would already consist of individuals with mutual trust of each other.

The ultimate goal of the research is to support development of a “reputation network” based on trust. To communicate the theory behind the filtering algorithms necessary for this SNA approach, there is a significant amount of statistical and graphing theory contained in the paper, including some abstract computer source code that may be a

bit complicated for some readers. However, the paper contains references to several initiatives being developed in Web technology organizations such as the World Wide Web Consortium (W3C) that may project more practical views of how this research would be deployed and appreciated, including discussion of the Google PageRank product as an exemplar product that could enable this capability.

Guy, I., Jacovi, M., Meshulam, N., Ronen, I., & Shahar, E. (2008). *Public vs. private: Comparing public social network information with email*. In *Proceedings of the 2008 ACM conference on Computer supported cooperative work* (pp. 393-402). doi: 10.1145/1460563.1460627.

This paper addresses the privacy issues related to mining and analyzing social network data. In particular, the authors identify email as a significantly challenged SNA data source from a privacy consideration and through experimentation validated that equivalent richness of email based SNA could be derived from “public” Internet and intranet data such as with blogs and wiki postings. The study correlated corporate email derived social network data with publically available data, and data propose a system design that will support this type of SNA activity without infringing privacy.

After citing the value of social network data, the authors reflect on the traditional utilization of surveys and interviews to collect social information data. These techniques implicitly reflect the willingness of the individuals being surveyed as the open gate to what would be considered private data. In this context, however, the authors specifically identify email data as having a SNA richness that mirrors and potentially surpasses data that would traditionally be collected by survey, and note that it is readily available to an organization with typical IT infrastructure, but is considered sensitive and private.

The value of this paper from the context of this bibliography scope is really more about the profiles of the people and their habits or tendencies to post personal data to public sites. From an OD practitioner perspective, if there is an inherent privacy challenge to conduct SNA on private email networks, the practitioner needs to consider the profiles of the client organization employees: Older and less tech-savvy employees don't have a strong public data "presence." Thus, for an OD practitioner to consider using email-based SNA, it may be better to work through privacy issues upfront with the client system organization to obtain access to this data. Consideration of technologies that would explicitly provide anonymity may become essential for some OD efforts.

Hangal, S., Lam, M. S., & Heer, J. (2011, October). *Muse: Reviving memories using email archives*. Paper presented at the *2011 ACM Symposium on User Interface Software and Technology*, Santa Barbara, CA. doi: [10.1145/2047196.2047206](https://doi.org/10.1145/2047196.2047206).

This paper reflects a perspective of email-based SNA that is by design focused on individual relationship and subject context analysis. Memories Using Email (MUSE) is a tool developed for individuals to mine their email archives to rekindle their memories, not unlike sorting through a box of old photographs. This tool capability is in a sharp contrast to typical interrelational analysis of SNA's focus, and it rather functions more like tools of an intelligence analyst. MUSE is designed for a layman (vs. a trained intelligence analyst) and facilitates the user traversing email archives in a very content-sensitive manner. In this effort, the tool generates cues such as inferred social groups, recurring named entities, occurrence of sentimental works, as well as image attachments, that the user can correlate into streams of "email sentiment" and "group communication" graphed by MUSE.

The value of MUSE to an OD practitioner would be “touchy.” By intent and design of the author, MUSE deeply penetrates and analyzes private issues reflected in personal email archives. However, if this were applied to corporate knowledge capture, such as deriving a “best practices analysis,” MUSE could help a subject matter expert walk through years of “experience” captured in an email archive, which would include relationships with organizations and particular problem domains. Thus, to an OD practitioner, this may be a tool to support sophisticated employee surveys and questionnaires as part of the OD diagnostic process, as defined by Brown (2011). The MUSE tool would be able to support derivation of longer-term cultural changes in the organization, as well as underlying evolutionary trends and key events, without the limitation of employee memory (or possibly limitation of employment status).

Hatala, J. (2006). Social network analysis in human resource development: A new methodology. *Human resource development review*, 5(1), 45-71. doi: 10.1177/1534484305284318.

As captured in the title of the paper, this paper focuses on application of SNA toward human resource development (HRD), specifically “increasing organizational effectiveness through the use of learning and performance improvement methods.” Noting that “[an] individual[’s] behavior is a reflection of the environment,” the author focuses the SNA toward “understanding interpersonal relationships” and “contextual factors” that impact the individual. The author specifically states SNA provides HR practitioners analysis of “interaction between individuals and their environment that have not been readily available,” and cites modern computer capabilities as a key enabler to individual research in this area. From an OD perspective, these HRD initiatives are simply a subset of the bigger OD mission and therefore are all applicable from a practitioner domain (or

problem space) perspective. Therefore, no caveats are needed as to OD being a target audience for this research study.

The approach of this paper is of great significance to the OD practitioner, since its method is a comprehensive literature review that (re)visits social network theory, disciplines that have adopted SNA in their research, discovery of SNA resources that can support the HRD initiatives, and research directions and implications for HRD leveraging of SNA. Thus, an OD practitioner would be well served to review this paper in order to come to terms with this paper's focus areas as a professional foundation for SNA application in practice.

The paper provides well-written decomposition and perspectives of applied SNA, introducing key terminology and concepts, and providing models for how SNA data are presented, with a minimal need for mathematical skills. The flow of the document correlates well with the OD processes outlined by Brown (2011), in particular the section on "SNA in HRD Practice".

Laclavik, M., Dlugolinsky, S., Seleng, M., Ciglan, M., & Hluchy, L. (2012). *Emails as graph: Relation discovery in email archive*. In *WWW 2012 Companion* (pp. 841-846). doi: 10.1145/2187980.2188210.

After a very brief introduction on the merits of email in supporting SNA, this paper focuses deeply into algorithm design and performance issues with email based SNA. Of particular interest is that this paper leverages the Enron email archives that became public record due to the criminal investigation of that company. (*Note: The Enron archive has become almost a de facto standard for evaluating email analysis tools.*) In this effort, the authors have created the "Enron Email Graph," leveraging their "gSemSearch" tool, with

this paper describing and comparing the particular theories, tools, and analysis utilized in its production.

An understanding of the paper leans somewhat heavily into requiring software architecture and programming knowledge, as well as requiring advanced (e.g., senior undergraduate computer science) knowledge of graph theory and data structures. The outputs of the studies, however (i.e., not looking under the hood), should be readily understandable and appreciable by an OD practitioner. Thus, the value of this paper to the OD practitioner would be providing a foundation to communicate with SNA analysis tool developers and researchers for developing more advanced analysis capabilities. It would not be useful to the OD practitioner who is looking for more “turnkey” approaches or tools, or for those who are squeamish about advanced math concepts. Also of note is that the authors of “gSemSearch” tool demonstrated significant scalability in managing the Enron email archive, and would therefore provide a valuable tool (with the necessary talent to tame it) in SNA of large corporate email archives.

Li, W., Hershkop, S., & Stolfo, S. (2004, October). *Email archive analysis through graphical visualization*. Proceedings of the 2004 computer and communications security workshop on visualization and data mining for computer security, Washington DC. doi: 10.1.1.84.6358.

This paper highlights the capabilities and research application of the Email Mining Toolkit (EMT), as a resource for SNA of email archives. Developed at Columbia University, the primary focus of EMT is to “compute behavior profiles of user email accounts,” and includes powerful visualization tools to display these profiles. A novel

concept of the tool is the introduction of “cliques,” and the ability to model participation within the cliques.

The EMT tool supports development of filters to identify behaviors within the cliques, with the intended use to identify rogue email behavior. However, to an OD practitioner, the EMT may provide a valuable capability to analyze more organizational or social group and team behaviors. In particular, EMT provides very versatile visualization capabilities (which are the focus of the authors’ paper), including a novel “Clique Panel” which provides colored plots of email behavior. This visualization capability, and others introduced in the paper, may be a valuable tool to communicate otherwise complicated data to client system leadership, in support of OD change campaigns.

Thus the value of this paper to the OD practitioner is to gain insight into the EMT, and possibly develop EMT clique filters to support OD efforts with real client systems. The paper does not require advanced knowledge of network technologies nor mathematics, and, although it is authored by computer technology experts, an OD practitioner should be able to read it with strong comprehension.

MacLean, D., Hangal, S., Teh, S., Lam, M., & Heer, J. (2011, February). *Groups without tears: Mining social topologies from email*. Paper presented at International conference on intelligent user interfaces 2011, Palo Alto, CA. doi: 10.1145/1943403.1943417.

This research provides focus on two email SNA areas: Mining and classifying social networks (as topologies) from email data, and the visualization of these networks. In the context of mining and classifying, the authors propose “social topologies” as a “set of potentially overlapping and nested social groups that represent the structure and content of a person’s social network.” Also introduced is the concept of a “social molecule” as a

“group of people that comprise a logical social unit” and are a building block of the topologies and part of the topology algorithm. After execution of their defined algorithms to derive social topologies from email data, they later validated them by interviewing the email account owners. However, the study explicitly recognizes that the derived social relationships change in “fine granularity,” and development of future techniques to observe these social topology changes is necessary. The authors present several considerations and references to related work for how to adopt a type of “learning” capability that could track these changes of social relationships.

From an OD perspective, this study is significant in that it is intended to “capture the nuances of social context that exist in real life,” making it potentially valuable in analyzing organizational behavior (including cultural aspects) in OD change campaigns. If a learning-type tool could be adopted and deployed to an OD change campaign, feedback of OD change initiatives may be observable in near real time by continual analysis of a client system’s email traffic.

The second part of the research (and an essential part to the first) is addressing the visualization of the social topology data. The authors identify and propose several available products—most notable SocialFlows, ContactMap, and Soylent—as readily available tools to pursue their research. The capabilities and limitations of these tools, in the context of their research, are outlined.

The later part of the paper goes into mathematical detail of the social topology mining algorithm, and quickly becomes interlaced with set theory and probability. Following this section, it enters usability studies of the tools evaluated to support the research.

Unfortunately, this paper reads like three or four papers merged, and it lacks a clear flow of ideas. The authors should have moved the evaluations of the tools to an appendix, instead of interlacing them with research concepts and analysis. With that said, the premise of the research is important from the perspective that it could offer an OD practitioner a valuable organizational analysis and feedback capability.

McCallum, A., Wang, X., & Corrada-Emmanuel, A. (2007). Topic and role discovery in social networks with experiments on enron and academic email. *Journal of Artificial intelligence research*, 30(1), 249-272. doi: 10.1613/jair.2229.

This paper introduces an evolution of mathematical attribute models to support SNA, focused on context attributes such “language content” or “topic.” The model proposed builds on the Latent Dirichlet Allocation (LDA) model, and the Author-Topic (AT) model to add attributes of the receiver and thereby facilitate LDA discovery of topics leveraging the author and receiver relationships. The proposed author-receiver-topic (ART) approach was executed against the Enron email corpus, as well as another research email archive, demonstrating better discovery of topics as well as role prediction. The model extended explicitly with role attributes (i.e., RART) also is presented as a foundation for future work.

The proposed ART approach is rather intuitive in nature once understood: Compare the context of the email (e.g., topics, key words, language, etc.) with the send/receive pair and a relationship can be derived between the individuals because of the email context. As exchanges between the send/receive pair continue under sustained topic or context, the roles of the individuals can be derived with the additional richness of the email context data set.

To the OD practitioner (and despite the paper being a rather heavy theoretical read), this is significant research since it promises greater insight into organizational behavior from a given email dataset. Citing the work as “person-conditioned topic distributions,” the ART and RART models better measure similarity between people, and therefore can discover people’s roles better. If a client system organization under an OD campaign has (say) significant undercurrents of informal relationships or cultural schisms that do not inherently support organizational performance goals, research models such as ART and RART applied to email data may someday be able to pinpoint these problem areas even in large-scale virtual organizations.

McLinden, D. (2012). Concept maps as network data: Analysis of a concept map using the methods of social network analysis. *Evaluation and program planning*, 36(1), 40-48. doi: <http://dx.doi.org/10.1016/j.evalprogplan.2012.05.001>.

Per the author, concept mapping (CM) has long been used to support brainstorming and idea generation efforts due to its inherent ability to map unstructured “thoughts, ideals and planned actions” offered by multiple stakeholders. In this research, the author proposes that CM could benefit from an infusion of SNA techniques and outlines advantages and disparities among CM and SNA that arose from his analysis. However, from an OD practitioner perspective, the value of this paper probably comes from looking to CM to augment SNA efforts. The document structure and information flow readily support this reversed perspective, and the author provides a comprehensive comparison of CM and SNA, focusing on comparison of supporting data structures and methods between the two. The case study provided is grounded first in CM principles, and then extends the analysis

to SNA methods, but it's not a stretch to reflect on the mutual values and disconnects that arise in this case effort from an opposite SNA-driven perspective.

Even if an OD practitioner is equally versed in CM and SNA approaches, the paper provides significant value in considering the contrasts between (say) the transfer of ideas in SNA, vs. the mapping of ideas in CM. This contrast naturally raises interesting concepts of how ideas (as motivations or cultural norms) could surface within an SNA analysis of organizational email traffic, leaning on CM methods and data structures to capture and reflect them.

The author clearly expresses the CM and SNA concepts through well-developed and -described graphs. No complicated mathematical concepts are expressed, although a basic knowledge of matrices would be useful for some of the discussions. A thorough understanding of the research material would benefit a seasoned OD practitioner who is employing SNA techniques.

McLinden, D. (2012). Concept maps as network data: Analysis of a concept map using the methods of social network analysis. *Evaluation and program planning*, 36(1), 40-48. doi: <http://dx.doi.org/10.1016/j.evalprogplan.2012.05.001>.

Agent-based simulations are based on nodes representing individuals or groups that function as independent entities behaving primarily on statistically driven behavior, and are frequently employed in analyzing behaviors of complex organizations or systems. There are two specific novelties in this research paper that make it appealing to an OD practitioner utilizing SNA techniques. The first is that the model reflects both the social (or informal) organization derived from email traffic, as well as the formal organizational structure. This mash-up provided for measures of input and output Degree (i.e., number of

direct connections), Distance (as the minimum number of links to all nodes) and Closeness (to neighbors as an average), Power Index (influence based on relative position in the network) and Faction (subgroup) analysis, in comparison between the formal and social organizational structures.

The second novel thing this study performed is that it simulated a reorganization, and then reanalyzed the above metrics as an after-effect of the reorganization. The simulation analysis displayed clear increases in Distance and Closeness measures, indicating degradation in organizational communication effectiveness because of the reorganization.

From the perspective of an OD practitioner, this paper can serve as an example approach for a basic SNA effort that covers the novelties of comparing a formal network with a social network, as well as analyzing communication behavior after change in formal organizational structure. The study also displays visualization examples of these metrics.

Murshed, S., & Hossain, L. (2007). *Exploring interaction patterns of cohesive subgroups during organizational disintegration*. In *Proceedings of the 8th ACM SIGCHI New Zealand chapter's international conference on Computer-human interaction: design centered HCI* (pp. 59-66). doi: 10.1145/1278960.1278969.

This research reflects an extremely interesting study to an OD practitioner. In this study, the authors perform a comprehensive SNA effort on the Enron Corp. email traffic generated during the fall of the company. In particular, it derived social network patterns and behaviors particular to the disintegration of Enron, leaning on the concepts of “cliques.”

The paper itself contains a lot of the information describing the debatably ethical and proven criminal acts performed by the organization. This background information is provided to highlight the key events leveraged to correlate (via the email timestamps) to changes in organizational clique behaviors, most notably the increased rate of creation and size changes of these cliques.

The study also provides significant detail into the mathematics behind tuning the SNA tools utilized for the study. Given that this is a postmortem analysis of the Enron falling, some questions to this analysis tuning should be raised to assure it was not “tuned for success.” However, the behaviors reflected, specifically the formation of clusters of cliques (probably whispering by the water cooler), are intuitively appreciable given typical human behavior.

From an OD practitioner perspective, it seems intuitively true that SNA patterns from this analysis could be applied to analysis of large corporations that hint at having challenges similar to those of the Enron Corp. in its downfall. Trends in clique behavior may be a key indicator for needed interdiction with OD practices to salvage a company. The study also identifies key software tools utilized in the analysis, as a reference to an OD practitioner looking to acquire this SNA capability.

Musial, K., Kazienko, P., & Brodka, P. (2009, June). *User position measures in social networks*. Paper presented at the third international workshop on social network mining and analysis, Paris, France. doi: 10.1145/1731011.1731017.

This paper provides a comprehensive overview of essential SNA centrality measures, to support analysis of an individual’s (or actor’s) features, characteristics, and importance within a social network. These measures (or metrics) include in and out degree

centrality, proximity prestige, rank prestige, node position, excentrality, closeness centrality, and betweenness centrality. Although the paper is heavily enriched with mathematical descriptions of these measures, it includes a set of practitioner-friendly tables that clearly define the key properties of these centrality measures, and practical examples of application.

As part of the centrality measures, the authors point out several shortcomings with the measures that should be recognized if an OD effort were to leverage them. Also discussed is the efficiency of the measure algorithms, which would be significant to estimate necessary computational resources and analysis times if this were to be applied to large email data sets. This information would give an OD practitioner a trade-space for decisions weighing timeliness of simplified analysis results against processing intensive but more comprehensive results.

To the mathematically inclined, the paper provides significant insight into the foundations and value of each of the presented metrics. But even without mathematical expertise, an OD practitioner is well served in a study of the presented centrality measures as a practical analytical foundation to SNA based OD ventures.

Rowe, R., Creamer, G., Hershkop, S., & Salvatore, S. (2007, August). *Automated social hierarchy detection through email network analysis*. Paper presented at the 13th ACM SIGKDD international conference on knowledge discovery and data mining, San Jose, CA. doi: 10.1145/1348549.1348562.

This research is yet another SNA effort that focused on the analysis of the Enron Corporation email dataset, publically released in course of the criminal investigation of that company during its downfall. A particularly interesting citation within the introduction is

that the authors identify an “increased need to analyze these vast stores of electronic information in order to define risk and identify any conflict of interest among the entities of a corporate household.” Thus, this study has a partial focus on identifying social network patterns that could indicate “money laundering, telephone fraud detection, crime detection and surveillance of the NASDAQ and other markets.” This concept introduces significant professional and ethical considerations for OD practitioners who may find themselves with the confidence of their target client, and at the same time have indications of criminal activities as a result of their SNA activities.

This study extends on previous work that focused on cliques, and introduces a “social score,” as a measure to better correlate individuals for purposes of constructing the social network reflected in the email data. The analysis also inserted response time to the analysis, noting that faster-than-average responses were typical among the key individuals in the criminal misdeeds. The results produced what the authors called “the real relationships” in the Enron corporate hierarchy that “an official corporate organization chart simply could not offer.” It also was noted that this social structure was significantly different from the formal structure.

To the OD practitioner, this paper is a worthwhile study simply to reflect the potential power of email-based SNA in support of OD data analysis and intervention. There is a significant amount of higher mathematical information contained within the study, but reading around the mathematical detail still provides significant insight into the value of the approach demonstrated by the authors.

Glossary of Acronyms and Terms

AAW	Army Acquisition Workforce
BBP	Better Buying Power
CMMI	Capability Maturity Model Integrated
CMU	Carnegie Mellon University
DAU.....	Defense Acquisition University
DoD.....	Department of Defense
FCS	Future Combat System
H ₀	Null Hypothesis
H ₁	Alternate Hypothesis
IPT	Integrated Product Team
LCMC	Life Cycle Management Command
OD.....	Organizational Development
PEO.....	Program Executive Office
PMO.....	Program Management Office
R&D.....	Research and Development
SEI	Software Engineering Institute
SNA	Social Network Analysis
TQM.....	Total Quality Management
ULSO	Ultra-Large-Scale Organization
ULSS.....	Ultra-Large Scale Systems
USA	United States Army
USAF	United States Air Force
USD(AT&L).....	Under Secretary of Defense for Acquisition, Technology and Logistics

Appendix A—Survey Career Program Options

CP10 Civilian Human Resource Management
CP11 Comptroller
CP12 Safety and Occupational Health Management
CP13 Supply Management
CP14 Contracting & Acquisition
CP15 Quality and Reliability Assurance
CP16 Engineers & Scientists (Non-Construction)
CP17 Materiel Maintenance Management
CP18 Engineers & Scientists (Resources and Construction)
CP19 Physical Security & Law Enforcement
CP20 Quality Assurance Specialist (Ammunition Surveillance)
CP22 Public Affairs & Communications Media
CP24 Transportation
CP26 Manpower & Force Management
CP27 Housing Management
CP28 Equal Employment Opportunity
CF29 Installation Management
CP31 Education Services
CP32 Training
CP33 Ammunition Management
CP34 Information Technology Management
CP35 Intelligence
CP36 Modeling and Simulation (M&S)
CP50 Military Personnel Management
CF51 Morale, Welfare, & Recreation
CF52 Chaplain
CF53 Medical
CF55 General Inspection, investigation, & Compliance
CF56 Law
CF57 Administrative & Office Support
CF58 Real Estate
CF60 Foreign Affairs
CF61 History
CF62 Troop Support
CF63 Mortuary Affairs
CF64 Aviation
CF70 Eyeglass Making & Medical Equipment Repair
CF71 Laboratory Work
CF72 Rubber, Plastic, & Glass Work
CF74 Transportation Facilitating
CF77 Facilities Operations & Maintenance
CF78 Troop Support (Wage Grade)
CF79 Instrumentation/Optical Working
CF80 Machine Tool Work

CF81 Metal Processing and Working
CF82 General Equipment Maintenance & Fabrication
CF83 Chemical Plant & Gas/Radiation
CF86 Disposal Management
CF87 Insect & Animal Work
CF88 Equipment Operating
CF89 Security Equipment Operating
CF90 Ammunition/Explosive & Firepower Work
CF91 Warehousing Stock Handling, Packing & Packaging
CF92 Tank Driving
CF93 Aircraft Maintenance
Other

